II. A SCORPION-FLY FROM THE GREEN RIVER EOCENE.

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(Plate XII)

While recently visiting the Carnegie Museum I examined a large collection of insects from the Green River (Eocene) shales of Colorado, and was delighted to find a very perfect scorpion-fly. The National Museum material from this deposit, consisting of about six hundred insects, does not contain a single Mecopteran, and the specimen mentioned above was the only one which I observed in the collection of the Carnegie Museum, comprising over eight thousand insects.

I am very grateful to Dr. Avinoff, the Director of the Carnegie Museum, for the kindness and courtesy which made my visit so pleasant. To Dr. Tolmachoff and especially to his assistant, Mr. Kay, I am indebted for their efforts to make my short stay so profitable. In working out the affinities of this fossil I have been fortunate in having the valuable criticism of Mr. Nathan Banks, who has specialized for many years in the *Mecoptera* and related forms.

Scorpion-flies have been found preserved in very ancient deposits. Tillyard is convinced that *Metropata pusillus* Handlirsch, from the Lower Pottsville series of the Pennsylvanian, and one of the eight oldest fossil insects known, belongs to this order. At any rate, fifteen species of unquestionable *Mecoptera* have been described from the Lower Permian of Kansas, representing families similar to and probably ancestral to the *Choristidæ*, *Panorpidæ*, and *Meropidæ*. A much larger number of species have been described from several Jurassic deposits of Europe and Asia. Tillyard regards these Jurassic forms, most of which belong to the extinct family *Orthophlebiidæ*, as the direct ancestors of the *Panorpidæ*; but Hagen long ago claimed that the wings of these insects had more trichopterous than mecopterous tendencies, and there seems to be evidence in favor of Hagen's conclusions, at least with reference to some species. One specimen of *Orthophlebia*, (from the Lias of Warwickshire, and specifically close to the genotype, *O. communis* Westwood), in the Museum of Com-

parative Zoölogy, has a granular wing surface, strikingly similar to that of many Limnophilids; there is no pterostigma, but R_1 has near its termination the decided downward curve, which is commonly found in *Trichoptera*; and Cu_1 disappears basally into the wing-membrane, another character frequently seen in the caddis-flies.

However, it is not until the Tertiary that we find *Mecoptera* which can be assigned to living families. Previous to the discovery of this Eocene specimen, the oldest Tertiary records have been in the Baltic Amber, which has yielded one species belonging to the *Panorpidæ* (*Panorpa brevicauda* Hagen) and two species of *Bittacidæ* (*Bittacus validus* Hagen and *Bittacus antiquus* Pictet). The Miocene beds at Florissant have produced three panorpids (*Panorpa rigida* Scudder, *P. arctiiformis* Ckll., and *Holcorpa maculosa* Scudder). In addition to these Cockerell has described two other species from Florissant: *Eobanksiana bittaciformis* (*Eobanksiidæ*) and *Eomerope tortriciformis* (*Meropidæ*). The first of these is certainly not a scorpion-fly of any kind, as Cockerell has recently shown, and the descriptions and figures of the second indicate that this also does not belong to the order. The Miocene of Siberia (Maritime Province) has yielded one specimen, *Dinopanorpa megarche* Ckll., consisting of a large, incomplete hind wing, with generalized panorpid characters, but uncertain generic affinities. Finally, Heer has described *Bittacus reticulatus* from the Miocene beds of Radoboj, but the small fragment of the wing, on which the species is based, shows no mecopterous characters whatever.

This new Scorpion-fly, having a single, predatory claw on each tarsus and the typical venation of *Bittacus*, belongs without question to the *Bittacidæ* and is therefore not only the earliest known member which can be referred to a living family of the order, but is the most ancient Mecopteran known to have predatory habits.

PALÆOBITTACUS, gen. nov.

Insects of about the size and habitus of *Bittacus*, but antennæ somewhat shorter; legs long and slender, each with a single, predatory tarsal claw; basal joint of hind tarsus longer than the fourth. Wings moderately slender, narrowed basally, the apical part broader than in *Bittacus*; pterostigma large and well developed; radial sector originating at about the same distance from the base of the wing as in

Bittacus, but forking much sooner; base of the radial sector joined to the media by a stout cross-vein; media fused basally with the first branch of the cubitus; 1A free from Cu_1 in the fore wing, but, apparently fused to Cu_1 in the hind wing. The main cross-veins in the apical part of the wing are arranged in a manner identical with that in *Bittacus*. Genotype: *Palæobittacus eocenicus*, sp. nov.

Mr. Banks was first to recognize the generic significance of the cross-vein joining the base of the radial sector with the media. In other Tertiary and all living species of Mecoptera this part of the wing is without cross-veins, but three species from the Lower Permian of Kansas have cross-veins at this place: *Protochorista tetraclada* Tillyard, *Permopanorpa schucherti* Tillyard, and *Platychorista venosa* Tillyard. It is not to be supposed, of course, that there is any homology between the cross-veins in the Permian forms and the one in the Eocene species, but its presence in some Palæozoic types and complete absence in Mid-tertiary and recent forms suggest that such a vein is indicative of a primitive condition. This character and the diffuse pterostigma leads us to believe that *Palæobittacus* is very close to the ancestor of *Bittacus*.

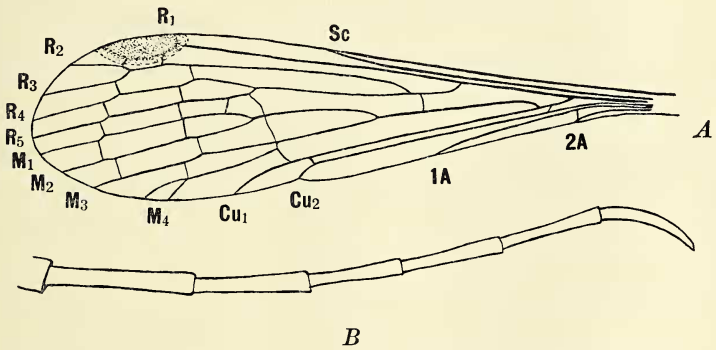

Figure 1. A: Fore wing of *Palæobittacus eocenicus*, n. sp. Sc, subcosta; R_1, first branch of radius; R_2 to R_5, branches of radial sector; M_1 to M_4, branches of media; Cu_1 and Cu_2, branches of cubitus; 1A, first anal; 2A, second anal.
B: Hind tarsus of *Palæobittacus eocenicus*, n. sp.

Palæobittacus eocenicus, n. sp.

(Text-figure 1; Plate XII, figures 1 and 2.)

Length of entire body 13 mm.; length of abdomen, 10 mm.; thorax, 2 mm.; antennæ, 4 mm.; front and middle legs, 18 mm.; hind legs, 15 mm.

Fore wing: 14 mm. long; greatest width 3 mm. Subcosta terminating at about the middle of the wing, the cross-vein joining it to the radius situated well beyond the origin of the radial sector; R_1 nearly straight; radial sector arising at a distance of about one-fourth the length of the wing from the base, immediately dividing into its two main branches; all four branches of the sector simple, R_{2+3} dividing just below the pterostigma, R_{4+5} forking at a point halfway between its origin and the apex of the wing; R_{2+3} joined to the pterostigma by two cross-veins; media separating from Cu_1 near the base of the wing, and dividing into M_{1+2} and M_{3+4} apically of the origin of the radial sector; the first three branches of the media simple, the fourth bifurcate at its tip; M_{1+2} dividing almost below the forking of R_{4+5}; M_{3+4} dividing slightly more basally; Cu_1 close to Cu_2 for nearly its entire length, diverging slightly at its termination; 1A short, terminating at a point just under the cross-vein joining the radial sector and the media; 2A terminating somewhat apically of the separation of the media and Cu_1; 3A is not preserved in the specimen.

Hind wing: 14 mm. long, greatest width 2 mm.; apex much more pointed than in the fore wing. The venation seems to be identical with that of the fore wing, except in the apparent fusion of 1A and Cu_1, and the possible absence of the cross-vein between Rs and M. The hind wing is poorly preserved and shows only faint traces of the veins. Both wings are without color-markings.

The fossil shows a lateral view of the insect, with the left fore wing extending dorsad to the body, the right hind wing ventrad to the body, and the other two wings folded together over the abdomen. The specimen is probably a female. Holotype: No. 1 (Field No. 565), in the Carnegie Museum, Pittsburgh; collected by Mr. Earl Douglass, in the Lower Section of the Upper Green River, "about a quarter mile above the Continental Oil Shale Plant in Piceance Creek, and about two miles west of Rio Blanco, Colorado."

The importance of the Green River insect fauna, as a connection between those of the Jurassic and Mid-tertiary, has already been discussed by Cockerell. The discovery of a scorpion-fly in this deposit adds another order to those previously found, and its excellent preservation and interesting characters should arouse enthusiasm in fossils from this shale. The immense, unworked Carnegie collection, which contains a vast number of Hymenoptera, Coleoptera, Hemip-

tera, and particularly Diptera, is certainly unusual and most attractive, and should receive the attention of specialists in these groups.

Since the preceding description was sent to the press, Martynov has described several additional species of Mecoptera from the Jurassic of Turkestan. One of these, *Probittacus avitus*, he recognizes as being related to *Bittacus*, although he assigns it to the *Neorthophlebiidæ*, an extinct family of an orthophlebiid type. But *Probittacus* is so very close to *Bittacus* that it seems more logical to place it within the *Bittacidæ*, as a form ancestral to *Palaeobittacus*. It is more primitive than the latter genus in possessing a weaker pterostigma, and a deeper fork on R_4. The discovery of this Jurassic bittacid indicates that the family is geologically much older than has been supposed.

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